

Supplementary Materials for

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VEO Leadership and Lethality Submission - Supplementary Material

Minimum Detectable Effect Analysis

To characterize the design's sensitivity, we conducted simulation-based minimum-detectable-effect analyses of the $PS \times CIP1$ two-way contrast in M3, which carries the substantive moderation claim. For the focal contrast, we generated 200 synthetic datasets per effect-size grid point from a negative-binomial process matching the corresponding model's fixed-effects structure and dispersion (with the focal coefficient reset to a hypothesized log-IRR), refit the same model to each, and computed the proportion of replicates yielding $p < .05$ on the focal contrast.

For the $PS \times CIP1$ two-way contrast (effect grid 0.10–1.50 in steps of 0.10), power was 26% at $\log\text{-IRR} = 0.10$ ($\text{IRR} \approx 1.11$), 73% at 0.20 ($\text{IRR} \approx 1.22$), 99% at 0.30 ($\text{IRR} \approx 1.35$), and effectively complete ($\geq 99\%$) for log-IRRs of 0.40 ($\text{IRR} \approx 1.49$) or larger. By interpolation, the design supported approximately 80% power for two-way log-IRRs of roughly 0.21 ($\text{IRR} \approx 1.23$) and above. The observed $PS \times CIP1$ coefficient ($\log\text{-IRR} = 1.45$, $\text{IRR} = 4.26$) sits roughly seven times above this threshold. Full simulation results across the effect-size grid are reported in Table A1.

Table A1

Simulation-Based Power for the $PS \times CIP$ Two-Way Contrast in M3 Across a Grid of Hypothesized Effect Sizes

Hypothesized log-IRR	Equivalent IRR	Power	95% Sim. CI	Converged / 200
0.10	1.11	.263	[.201, .324]	198
0.20	1.22	.734	[.672, .795]	199
0.30	1.35	.985	[.968, 1.000]	196
0.40	1.49	1.000	[1.000, 1.000]	198
0.50	1.65	1.000	[1.000, 1.000]	196
0.60	1.82	1.000	[1.000, 1.000]	197
0.70	2.01	1.000	[1.000, 1.000]	199
0.80	2.23	1.000	[1.000, 1.000]	198
0.90	2.46	1.000	[1.000, 1.000]	198
1.00	2.72	1.000	[1.000, 1.000]	199
1.10	3.00	1.000	[1.000, 1.000]	199
1.20	3.32	1.000	[1.000, 1.000]	197
1.30	3.67	1.000	[1.000, 1.000]	199
1.40	4.06	1.000	[1.000, 1.000]	199
1.50	4.48	1.000	[1.000, 1.000]	198

Note. Each row reflects 200 parametric bootstrap iterations on the M3 fixed-effects structure with a negative-binomial data-generating process matched to the fitted dispersion. Power = proportion of replicates yielding $p < .05$ on the focal $PS \times CIP$ coefficient. Sim. CI = simulation-based 95% confidence interval on the estimated power. Equivalent IRR = $\exp(\log\text{-IRR})$. Convergence rates exceeded 196 / 200 across the grid. The 80% power threshold falls between log-IRRs of 0.20 and 0.30 ($IRR \approx 1.22$ to 1.35); by interpolation, the design supports approximately 80% power for log-IRRs of roughly 0.21.

Diagnostic Detail for Family Choice

Lethality was significantly skewed (skewness = 10.98) and the sample variance (634,856) exceeded the sample mean (178.4) by a factor of approximately 3,558. A Cameron and Trivedi (1990) regression-based dispersion test was performed on a marginal Poisson model. A marginal Poisson was used rather than a GLMM because the dispersion test requires a fixed-effects Poisson rather than a multilevel model. Further, the diagnostic choice is for the family choice and not for the inferential model. The dispersion test returned a dispersion estimate of approximately 2,022 ($z = 2.76, p = .003$), three orders of magnitude above the Poisson assumption of dispersion = 1. Under such conditions, Poisson GLMMs systematically underestimate standard errors, while the negative-binomial distribution accommodates excess variance through an additional dispersion parameter (Stroup, 2024).

Diagnostic for Zero Inflation

To assess whether such a specification was needed, we compared the observed and model-predicted number of zero years under the fitted model (M3). Diagnostic comparison of observed and model-predicted zero counts indicated adequate fit at the lower tail (observed zeros = 189; predicted zeros = 165; ratio = 0.87), within the range typically considered acceptable for negative-binomial GLMMs (Lüdtke et al., 2021, *performance* R package). We did not pursue a zero-inflated specification because the sampling frame restricts observations to leaders during their period of active operation, leaving no theoretically distinct structural-zero process to model.

Diagnostic for Autoregressive Effects

AR(1) was preferred over compound-symmetry and unstructured alternatives on the grounds of parsimony: it imposes a single autocorrelation parameter that decays geometrically with time lag, which is theoretically appropriate for evenly-spaced annual observations and substantially more identifiable than an unstructured covariance over up to 21 timepoints per organization (Singer & Willett, 2003).

We assessed the sensitivity of the focal interaction to influential cases by refitting the primary model with each leader excluded in turn (leave-one-out). Simulation-based minimum detectable effect analysis indicated that the design supported approximately 80% power for two-way log-IRRs of 0.21 ($\text{IRR} \approx 1.23$) or larger; the observed $\text{PS} \times \text{CIP}$ effect ($\text{log-IRR} = 1.45$) sits well above this threshold. As additional evidence of model fit, marginal and conditional R^2 were computed for each model with the Nakagawa approach implemented in the performance package (Lüdtke et al., 2021; Nakagawa et al., 2017). Marginal R^2 reflects variance attributable to the fixed effects; conditional R^2 additionally incorporates stable between-organization differences captured by the random intercept. Variance associated with the AR(1) serial-dependence structure is not part of this decomposition, and the partition of between-organization variance between the random intercept and the AR(1) component shifts across models, so conditional values should not be compared across models. Because the random-slope variance was estimated at the boundary of zero in M2 and M3, the decomposition required relaxing the singularity tolerance of the software; refits omitting the inert slope term yielded identical fit (for M3, $\chi^2[1] = 0.00, p > .99$) and left the focal interaction coefficient unchanged to four decimal places.

Diagnostic for Time Shape Selection

Time was operationalized as years since the start of the leader's tenure, and four functional forms were compared via AIC: linear, quadratic, cubic, and logarithmic (Table S2). Among the three that converged, the log specification achieved the lowest AIC and the linear

specification was within $\Delta\text{AIC} < 3$. The log transformation was retained both for parsimony and because it imposes a more theoretically defensible diminishing-returns shape on within-organization escalation. With this transformation, a one-unit increase in $\log(\text{time} + 1)$ corresponds to multiplying chronological time by $e \approx 2.7$.

Table A2

Time-Shape Selection: AIC Comparison Across Four Candidate Specifications for Time

Time Specification	Functional Form	df	AIC	ΔAIC
Logarithmic	$\log(\text{time} + 1)$	6	5640.10	0.00
Linear	time	6	5642.40	2.30
Cubic	$\text{time} + \text{time}^2 + \text{time}^3$	8	5644.18	4.08
Quadratic	$\text{time} + \text{time}^2$	7	—	—

Note. All models are negative-binomial GLMMs with random intercept for organization and an AR(1) structure on within-organization residuals; the only variation across models is the functional form of time. AIC = Akaike information criterion; ΔAIC = AIC relative to best-fitting model. The quadratic specification failed to converge; it is shown for completeness. The logarithmic specification was retained as the best-fitting model and is theoretically defensible as a diminishing-returns shape on within-organization escalation; the linear specification is within $\Delta\text{AIC} < 3$ of the log specification and produces nearly identical inferential conclusions when substituted into M3 (results available on request).

Random-effects Table

Table S3

Random Effects and Dispersion Estimates Across Candidate Models

Component	M0	M1	M2	M3
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$\sigma^2(\text{Intercept})$	< 0.01	< 0.01	0.06	2.09
$\sigma^2(\text{Slope on log time})$	—	< 0.01	< 0.01	< 0.01
$\rho(\text{AR1})$	.98	.98	.98	.97
$\sigma^2(\text{AR1 residual})$	9.32	9.30	9.32	6.06
Dispersion (k)	0.73	0.73	0.72	0.72
log-likelihood	-2814.05	-2813.77	-2812.44	-2806.13

Note. All models are negative-binomial GLMMs with log link, fit by maximum likelihood. $\sigma^2(\text{Intercept})$ = between-organization variance in log lethality. $\sigma^2(\text{Slope on log time})$ = between-organization variance in the time slope; reported as < 0.01 where the variance estimated to a value indistinguishable from zero. $\rho(\text{AR1})$ = first-order autoregressive correlation between adjacent within-organization residuals on the latent log scale. $\sigma^2(\text{AR1 residual})$ = variance of the AR(1) residual component. Dispersion (k) = negative-binomial scale parameter; values < 1 indicate variance-to-mean ratios increasing with the mean above the Poisson assumption. M0 contains no random slope on time. The dramatic shift in $\sigma^2(\text{Intercept})$ from M2 to M3 reflects the inclusion of the PS $\times$ CIP interaction, which absorbs cross-organization variance previously distributed across the AR(1) component.

Sample Distribution Across Design Cells

Table S4

Cell-Level Descriptive Statistics for Organizations and Organization-Years Across the PS $\times$ CIP Design

Power Orientation	Influence Style	Organizations (k)	Organization-Years (n)	Mean Time-Points per Org
Socialized	Charismatic	15	145	9.7
Socialized	Ideological	9	105	11.7
Socialized	Pragmatic	12	102	8.5
Personalized	Charismatic	9	77	8.6
Personalized	Ideological	16	151	9.4
Personalized	Pragmatic	7	65	9.3
Total		68	645	9.5

Note. PS = power orientation (socialized vs. personalized); CIP = influence style (charismatic, ideological, pragmatic). Organizations (k) = number of unique organizations contributing to each cell. Organization-Years (n) = number of yearly observations contributing to each cell. Mean Time-Points per Org = ratio of organization-years to organizations within each cell. The total of 68 organizations across cells exceeds the 67-organization analytic sample because one organization's PS or CIP coding changed during its height-of-power period, contributing to two

cells; this does not affect the fitted models, which use 68 unique leaders and 645 leader tenure-years.

Controlling for Organization Size

Turning to organization size, no source provides year-over-year membership estimates spanning this sample, so we merged the ordinal size classification from the Big, Allied and Dangerous database (Asal & Rethemeyer, 2008) as a time-invariant covariate and re-estimated the primary model on the size-complete subsample ($k = 28$ leaders, $N = 236$ leader-tenure years). Larger organizations were somewhat more lethal, $b = 0.51$, $SE = 0.27$, $z = 1.86$, $p = .063$, and adding size improved fit only marginally, $LRT \chi^2(1) = 3.52$, $p = .061$. The focal $PS \times CIP$ interaction attenuated but remained significant with size controlled, $b = 1.62 \rightarrow 1.38$, $p = .025$.

This size analysis warrants a specific caution. Because membership codings are unavailable for organizations whose leaders held power before the source database's coverage window, the size-complete subsample retains only 42% of leaders and 37% of leader-tenure years, and the loss is not distributed evenly across the design. The personalized-pragmatic cell, in particular, contains only two leaders (against seven socialized-pragmatic leaders), which is the contrast that carries the strongest simple effect in the full sample. The size-controlled interaction estimate should therefore be read as evidence that organization size does not overturn the focal interaction, not as an independent test of that interaction; the subsample is too thin in one design cell to support the latter. For the same reason, the intersection of the size-complete and ideology-complete subsamples ($k = 18$ leaders) is too small to support a stable model with both sets of controls, and we therefore report the ideology and size analyses on their respective subsamples rather than jointly.

Predictor Coding

Table S5

Dimensions of leader power orientation and the model of charismatic-ideological-pragmatic influence

Power Orientation	
Outcome Uncertainty	The degree to which the leader believed he or she would not get what he or she desired or valued because the world is uncertain and constantly changing.
Need for Power	The degree to which the leader sought to subdue or convert others to one's purposes by threat, promise of reward, or persuasion.
Object Beliefs	To view other individuals as instruments to be used to achieve one's own goals; failure to recognize others as individuals; to dehumanize others.
Negative Life Themes	The extent to which the leader had a destructive image of the world and his or her role in the world.
Narcissism	The leader's propensity to overvalue his or her own attributes or achievements; extreme self-interest and selfishness on the part of the leader; the degree to which the leader was overly concerned with self-satisfaction.
Fear	The strength of the leader's need to protect him/ herself; unwilling-ness to engage in activities which might be considered harmful or risky.
Self-Regulation	The leader's ability to monitor thoughts and actions in the presence of others; the degree to which the leader was honest about his or her negative attributes.
CIP Influence	
Time frame orientation	The temporal reference point used to guide the construction of a prescriptive mental model, leading to the selection and organization of key causes and goals (i.e. future, present, or the past)
Type of experience used	The use of positive or negative case examples to guide the construction of mental models (i.e. failure of the current system or positive examples of successful change)
Nature of outcomes sought	The type of goals or outcomes emphasized to frame mental model construction (i.e. positive, transcendent, or malleable)
Number of outcomes sought	The focus on a select amount of goals or outcomes in accordance with a prescriptive mental model (i.e. multiple, selected few, or variable)
Focus in model construction	The orientation towards internal or external demands as a guide to the construction of a prescriptive mental model (i.e. internal vs external)
Locus of causation	The guiding beliefs about the key causal forces that should be considered in the construction of a prescriptive mental model (i.e. people, the situation, or an interaction)
Controllability of causation	The guiding belief about an individual's ability to control the emphasized locus of causation (i.e. high, low, or variable)
Targets of influence	The group of followers that a leader specifically constructs their message to appeal towards (i.e. mass groups, those with similar beliefs, or select elites)
Crisis conditions	The critical contexts in which leaders are most likely to emerge (i.e. ordered, chaotic, or localized)
Use of emotions	The display and use of emotion as influence tactics to convey important information to followers and motivate action (i.e. positive, negative, or rational)